

**Remarks/Arguments:**

This is a reply to the office action of December 20, 2005. Claims 24 - 44 were rejected as indefinite under 35 USC 112, second paragraph, and also over prior art. The claims have been revised above to comply with the requirements of section 112, and also to better distinguish the invention from the prior art.

The examiner is asked to reconsider the objection to the specification. While the original specification was in Italian, and the English version is obviously a translation, we believe it describes the invention with sufficient clarity. We are of course willing to amend the specification to clarify any particular paragraphs the examiner thinks could be improved.

We have learned that the term "print" is a term of art, and enclose for the examiner's convenience a printout of an article found on the internet at [http://www.efunda.com/processes/metal\\_processing/sand\\_casting\\_intro.cfm](http://www.efunda.com/processes/metal_processing/sand_casting_intro.cfm), which describes and illustrates the meaning of the word. We believe "print" has been correctly used in the specification and the claims.

Regarding the claims, the Applicant agrees with the Examiner that the general idea of inserting the valve seats into a casting by connecting them to a destructible layer of the cores is known from Trumbauer et al. However, there are some important differences between this reference and the invention now claimed

In Trumbauer et al., the valve seat 12 is positioned around the core 10, 11 and then the assembly is placed into a mold for being covered by the expanded polystyrene (col. 6). That procedure is not sufficiently accurate to guarantee the exact positioning of the valve seat with respect to the combustion chamber of the engine, because the centering of the valve seat is completely reliant on the polystyrene. While acknowledging that

the correct positioning of the valve seat is very important for a good casting, Trumbauer et al. does not mention any other centering or positioning means. Moreover, since Trumbauer's valve seat 12 is positioned around the core after the core has been formed and therefore cannot be firmly fixed to the core, the insert 12 would slip off as soon as the core were inverted to be placed into the mold.

If one were to try to apply the teaching of Trumbauer et al. to a casting procedure using – instead of a mold – a chill, which reaches a very high temperature before receiving the molten metal, a correct positioning of the valve seat could not be obtained since the polystyrene would start dissolving long before it was replaced by the metal, thereby allowing the valve seat to move.

These problems are overcome by the present invention by positioning the valve seat in a respective seat in the die, instead of around the core, and by relying on geometrical coupling between the conical surfaces of the seat and of the core end. This coupling forces the seat to be centered in the die and aligned with respect to the core when the foam material is injected in the die.

Trumbauer et al. does not disclose or suggest a geometrical coupling between the insert and the core which constrains the insert to be always coaxial with the core, nor does it suggest placing the insert in a respective seat in the die, before the core.

Regarding the means for practicing the method, none of the cited references discloses a main core box (20) having a cavity in which there are seats (20') for receiving the cores with the valve seats attached.

Similarly, none of the cited references discloses a die having a cavity in which seats for receiving the valve seats are provided, the seats in the die having a depth which is less than the thickness of the valve seat so that the coating material partially envelops

the seat around its external surface.

Regarding the insertion of the valve guides, the Applicant does not agree that it would have been obvious for the skilled person to apply the pins disclosed in JP 363281760A to Trumbauer et al. in order to obtain the valve guides embedded in the casting.

Neither Trumbauer et al. nor JP '760 teaches one to make holes in the foamed material for inserting the valve guides. In particular, in JP '760, the pins 58a, 58b are not supported by the ducts cores 56e, 56f or by foamed material (which in this reference is not even present). On the contrary, the pins are supported only by the upper cores 56h, 56g. Furthermore, the pins do not reach the duct and therefore cannot act as valve guides, as in the present invention.

Actually, in JP '760 the pins act as plugs for conducting air tight tests on the casting at a certain pressure. As explained in the abstract and shown in Figure 1, once the casting has been obtained, the pins are removed and valve guides are inserted by machining in the holes thus obtained.

Starting from Trumbauer et al., the skilled person would have not found any suggestion in JP '760 for making holes in the ducts cores and in the foamed material for inserting valve guides.

With the present invention, the valve guides, partially inserted in the monolithic group of cores and foamed material (Figure 8), support and guide the upper core 21, centering it and maintaining the correct position with respect to the main core 11. This functional advantage is not provided by any of the cited references.

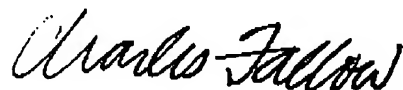
Finally, with reference to Figure 4, none of the prior art discloses a die which provides references for the correct positioning of the valve seats and which has pins (16, 17)

for the insertion of valve guides, where the axes of the pins and the references are coincident to produce perfect alignment between the valve guides and the valve seats.

We respectfully submit that the claims presented are patentable over the prior art of record, and that this application is now in proper condition for allowance.

One claim has been added. Please charge any extra claim fee due to Deposit Account 19-2110.

Respectfully submitted,



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## Sand Casting: Introduction

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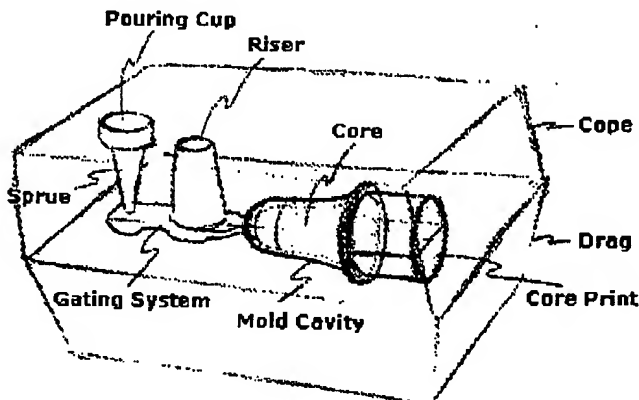
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## Introduction

Sand casting is used to make large parts (typically Iron, but also Bronze, Brass, Aluminum). Molten metal is poured into a mold cavity formed out of sand (natural or synthetic). The processes of sand casting are discussed in this section, include patterns, sprues and runners, design considerations, and casting allowance.

## Patterns

The cavity in the sand is formed by using a pattern (an approximate duplicate of the real part), which are typically made out of wood, sometimes metal. The cavity is contained in an aggregate housed in a box called the flask. Core is a sand shape inserted into the mold to produce the internal features of the part such as holes or internal passages. Cores are placed in the cavity to form holes of the desired shapes. Core print is the region added to the pattern, core, or mold that is used to locate and support the core within the mold. A riser is an extra void created in the mold to contain excessive molten material. The purpose of this is feed the molten metal to the mold cavity as the molten metal solidifies and shrinks, and thereby prevents voids in the main casting.



Typical Components of a Two-part Sand Casting Mold.

In a two-part mold, which is typical of sand castings, the upper half, including the top half of the pattern, flask, and core is called cope and the lower half is called drag. The parting line or the parting surface is line or surface that separates the cope and drag. The drag is first filled partially with sand, and the core print, the cores, and the gating system are placed near the parting line. The cope is then assembled to the drag, and the sand is poured on the cope half, covering the pattern, core and the gating system. The sand is compacted by vibration and mechanical means. Next, the cope is removed from the drag, and the pattern is carefully removed. The object is to remove the pattern without breaking the mold cavity. This is facilitated by designing a draft, a slight angular offset from the vertical to the vertical surfaces of the pattern. This is usually a minimum of  $1^\circ$  or 1.5 mm (0.060 in), whichever is greater. The rougher the surface of the pattern, the more the draft to be provided.

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### **Sprues and Runners**

The molten material is poured in the pouring cup, which is part of the gating system that supplies the molten material to the mold cavity. The vertical part of the gating system connected to the pouring cup is the sprue, and the horizontal portion is called the runners and finally to the multiple points where it is introduced to the mold cavity called the gates. Additionally there are extensions to the gating system called vents that provide the path for the built up gases and the displaced air to vent to the atmosphere.

The cavity is usually made oversize to allow for the metal contraction as it cools down to room temperature. This is achieved by making the pattern oversize. To account for shrinking, the pattern must be made oversize by these factors, on the average. These are linear factors and apply in each direction. These shrinkage allowance are only approximate, because the exact allowance is determined the shape and size of the casting. In addition, different parts of the casting might require a different shrinkage allowance. See the [casting allowance table](#) for the approximate shrinkage allowance expressed as the Pattern Oversize Factor.

Sand castings generally have a rough surface sometimes with surface impurities, and surface variations. A machining (finish) allowance is made for this type of defect. See [casting allowance table](#) for the finish allowance.

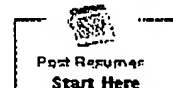
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